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AMENDED SPECIFICATION

Reprinted as amended in accordance with the Decision of the Superintending Examiner acting for the Comptroller-General dated the eighth day of May, 1962, under Section 14, of the Patents Act, 1949.

PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventors: WILLIAM REDE HAWTHORNE and JOHN CHRISTOPHER SHULDHAM SHAW.

824,984

Date of filing Complete Specification: April 1, 1958.

Application Date: March 13, 1957. No. 8272/57.

Complete Specification Published: Dec. 9, 1962.

Index at acceptance:—Classes 78(4), E11X; 113, A(1:4), B(4:16), CX9; and 114, K.

International Classification:—B63b, d. B66f.

COMPLETE SPECIFICATION

Improvements in or relating to Flexible Barges

We, DRACONE DEVELOPMENTS LIMITED, a British Company, of 7 Tilney Street, London, W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to flexible barges intended primarily for the transport and/or storage of liquids or solids including fluidized solids, that is to say solid cargoes such as wheat or other graain made fluid by being suspended in a liquid or rendered mobile by the presence of a gas.

The present invention aims at improving the stability of the barge and to this end the barge comprises an elongated fabric skin having cargo and pressure-fluid compartments which are in pressure-transmitting communication with one another and means for changing the pressure of the pressure-fluid whereby to change the pressure of the cargo. By this means the tension in the fabric wall of the barge and the period of sloshing of the liquid contents can be varied to improve the stability of the vessel particularly when under tow. The pressure can be prevented from increasing above a desired maximum by providing the barge with one or more relief valves which may be combined with one or more valves provided to relieve gas pressure.

Control of the pressure of the fluid in the barge or compartments of the barge may be achieved by controlling the admission of water to one or more compartments of the barge.

Such pressure control may additionally be obtained by direct water injection into the cargo spaces in the barge. The water compartments may be separated from the remainder of the volume of the barge by fabric diaphragms arranged for instance as flexible cones so that there is little or no stress in the diaphragm.

Alternatively, the water compartment may be in the form of one or more long tubes of fabric loosely connected to the barge. Water may be forced through a hose or hoses connected to the tubes so that they may be filled until the cargo, solid or fluid, is at the desired pressure.

The pressure in the water space or spaces and hence in the cargo-filled compartment or compartments of the barge is controlled by altering the volume of water in the water space or spaces. The volume may be fixed at the start of the voyage or may be made adjustable by a variety of means.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic side sectional elevation of the nose of a flexible barge according to the invention,

Fig. 2 is a diagrammatic side sectional elevation of the stern of a barge according to the invention,

Fig. 3 is a diagrammatic side sectional elevation of a float having means for pressurizing a barge having a stern as illustrated in Fig. 2,

Fig. 4 is a diagrammatic side sectional elevation of a modified form of barge according to the invention,

Fig. 5 is a cross-section of the barge illustrated in Fig. 4,

Fig. 6 is a diagrammatic side sectional elevation of an end of a barge, which end may form either the nose or the stern of a vessel similar to that illustrated in Fig. 4,

Fig. 7 is a cross-section of a modified form of barge,

Fig. 8 is a diagrammatic side sectional elevation of a still further modified form of barge according to the invention,

Fig. 9 is a view similar to Fig. 8 of a further modified form of barge according to the invention, and

Fig. 10 is a diagrammatic side sectional elevation of the nose of a still further form of barge according to the invention.

Referring first to Fig. 1 of the drawings, the barge indicated at 1 is divided into one or more cargo compartments 2 and one or more water compartments 3 by means of one or more flexible and loose diaphragm seals 4. A motorised pump 5 is arranged to pump water from the exterior of the barge through an inlet 6 into the water compartments 3 through a tube 7. The pumps may be driven by an electric or hydraulic motor or by an engine, and the mouth of the inlet 6 is provided with a filter 8. The pump 5 is also provided with a relief valve. The barge is towed by means of a towing bridle 9 and a tow rope 10 which may be of nylon, terylene (registered Trade Mark), steel, courlene (registered Trade Mark), or other materials known to be suitable for ropes. The tow rope is provided with an electric cable 11 for energising the motorised pump 5 and for transmitting control signals or information such as internal pressure readings, as well as for supplying power such as for navigation lights and radio beacons. Alternatively, information and control signals may be transmitted by radio.

The pressure in the water space or spaces and hence in the cargo-filled compartment or compartments of the barge is controlled by altering the volume of water in the water space or spaces by means of the pump 5. One or more of such pumps 5 may operate either under automatic or remote control to pump water into the pressurizing space until the pressure reaches a desired value. If the pressure exceeds the desired value the water may be released through the relief valve.

Figs. 2 and 3 illustrate modified arrangements in which the motorised pump and relief valve indicated at 15 are carried on a float 14, the inlet being shown at 16 and the filter at 18. Water is pumped into the water compartment 3 at the stern of the vessel (Fig. 2) through a pipe 17. Cargo, such as oil, is pumped into the cargo compartment 2 through a pipe 19 which passes through the diaphragm 4. Any suitable form of cargo filling valve and relief valve may be provided for the pipe 19 and is indicated at 20 in Fig. 3.

Figs. 4, 5 and 6 illustrate a further modified form of barge in which the skin of the barge is tensioned by pressurizing longitudinal compartments 21. These longitudinal compartments or ducts 21 are pressurized by means similar to those described above, for example, by communicating with the water space 3 as indicated in Fig. 6, whereby a longitudinal tension is established in the outer skin. Alternatively, the ducts themselves may become rigid longitudinally and support the remainder of the fabric against bending loads which would otherwise cause the barge to buckle and flutter.

A modified arrangement of the longitudinal ducts 21 is illustrated in the cross-sectional view of Fig. 7.

Instead of pressurizing the ducts with sea water pumped from outside, such ducts may be pressurized by pumping fluid cargo from a lower pressure compartment into the high pressure ducts. The pumps may be controlled and powered by means similar to those hereinbefore described. Fig. 8 illustrates an arrangements in which a water compartment 3 and a low pressure cargo compartment 2 are provided and also high pressure cargo or water compartments 23 which communicate with each other through a longitudinal central tube 24, the high pressure space thus formed being separated from the water compartment 3 by the diaphragm 4.

The duct may be made of fabric which for cheapness need not necessarily be impervious on the internal side when the ducts are filled with fluid cargo or on the external side when the ducts are filled with sea water. The loss of liquid due to seepage may be made up by the action of pumps. Seepage also prevents over stressing of the fabric when large forces are suddenly applied to the barge by wave or other action. Fig. 9 illustrates a further modified form of barge according to the invention in which one or more longitudinally extending water ducts 25 pressurized as hereinbefore described, are connected to the side walls of the barge by ties 26 and are spaced from the walls by floats 27.

Fig. 10 illustrates the instrumentation of the barge for measuring pressure by means of a pressure responsive diaphragm 28, and a pressure recorder 29. A flashing light or other indicator 30 is set to give an indication of when a predetermined pressure is reached and pressure signals may also be transmitted along the tow rope through a cable 11 as above described.

Alternative methods of pressurizing may involve the use of pressurizing gas from metal or plastic storage containers attached to a barge or to a float. The gas may be used

to pressurize directly or may drive a water pump or be used in a jet entrainment pump to force water or a mixture of gas and water into the pressurizing spaces. In some cases water or gas or mixtures of both may be additionally pumped or blown directly into the cargo spaces. Gas valves responsive to pressure in the barge may operate automatically or may be controlled from the towing vessel by cable or radio.

Another means of applying pressure to the barge is to pass a hose or flexible pipe from the towing vessel and to pump water, oil or other liquid or gas from the towing vessel when the pressure is low or return it by suction to the towing vessel when the pressure is too high.

The pipe line may be incorporated in the towing rope or cable or may be separated therefrom. In the latter case it may be shortened or lengthened as required by being passed over one or more drums. At each end of the pipe line valves may be installed which may close to seal off the pipe in the event of the occurrence of a fracture or leak. The winches or drums over which the pipe line passes may be arranged to rotate and to alter their distance apart. Several turns about two or more drums may be made so that the length of pipe paid overboard can be materially altered. The rotation of the drums and their distance apart may be controlled to keep in step with the rate of paying out and length of the towing cable.

Floating storage vessels may be emptied by displacing the stored material with water pumped into a compartment separated from the storage material by a sealing diaphragm of rubberised fabric which is of sufficient area to avoid stretching under all conditions of filling.

We are aware of specification No. 821,195 which, in its broadest aspect, claims protection for a floating container for the water transport of liquids by towing consisting of two or more cells, at least one being an air cell, characterised in that the shells of the cells are of flexible plastics material and the cells are fixedly or detachably connected together and are surrounded by an outer covering of flexible plastics material, each cargo-carrying cell having at least one closable filling aperture, the air cell being so disposed within the covering that a pressure increase acting on the cargo-carrying cells acts on the air cell and displaces air out of the air cell through a safety valve, and that the said container is provided with a network surrounding the cells, which network increases the strength of the container and takes up the tractive forces set up in towing. Such a floating container is hereby disclaimed from the protection defined by the following claims.

WHAT WE CLAIM, subject to the foregoing disclaimer, is:—

1. A flexible barge comprising an elongated fabric skin having cargo and pressure-fluid compartments which are in pressure-transmitting communication with one another and means for changing the pressure of the pressure-fluid whereby to change the pressure of the cargo.

2. A flexible barge as claimed in Claim 1, wherein control of the pressure of the fluid is achieved by controlling the admission of water to one or more compartments of the barge.

3. A flexible barge as claimed in Claim 2, wherein the water compartment or compartments is or are separated from the remainder of the volume of the barge by a diaphragm or diaphragms.

4. A flexible barge as claimed in Claim 3, wherein the diaphragm or diaphragms is/are of fabric and in the form of a flexible cone such that there is little or no stress in the diaphragm(s).

5. A flexible barge as claimed in Claim 2, wherein the water compartment or compartments is or are in the form of one or more long tubes of fabric loosely connected to the barge.

6. A flexible barge as claimed in any of the preceding claims, having a pump arranged to pump water from the exterior of the barge into the water compartment or compartments.

7. A flexible barge as claimed in Claim 6, wherein the pump is mounted on a float connected to the water compartment or compartments by means of a pipe.

8. A flexible barge as claimed in Claim 7, wherein the float also carries a cargo filling valve connected by a pipe to the cargo space of the barge.

9. A flexible barge as claimed in Claim 2, wherein the water compartments are in the form of tubes mounted on the inside of the wall of the barge.

10. A flexible barge as claimed in Claim 2, wherein the water compartment is in the form of a central tube communicating with water compartments at opposite ends of the barge.

11. A modified form of the barge claimed in Claim 10, wherein the central tube and the end compartments are adapted to be pressurized by pressurizing liquid cargo and a separate water space is provided at one or both ends of the barge and separated from the pressurized cargo space by means of a diaphragm, said central tube being surrounded by a low-pressure cargo space.

12. A flexible barge as claimed in any of the preceding claims, having a tow rope furnished with an electric cable conductor adapted to supply electrical power to the barge

and to transmit signals between said barge and a towing vessel.

13. A flexible barge substantially as hereinbefore described with reference to any of the figures of the accompanying drawings.

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Agents for the Applicants.

PROVISIONAL SPECIFICATION

Improvements in or relating to Flexible Barges

We, DRACONE DEVELOPMENTS LIMITED, a British Company, of 7 Tilney Street, London, W.1, do hereby declare this invention to be described in the following statement:—

This invention relates to flexible barges intended primarily for the transport and/or storage of liquids or solids including fluidized solids, that is to say solid cargoes such as wheat or other grain made fluid by being suspended in a liquid or rendered mobile by the presence of a gas. The invention is not, however, limited to the particular cargo intended to be transported.

The present invention aims at improving the stability of the barge and to this end means is provided for changing the pressure of fluid contained in the barge or in some subdivisions or compartments of the barge. By this means the tension in the fabric wall of the barge can be increased to improve the stability of the vessel particularly when under tow. The pressure can be prevented from increasing above a desired maximum by providing the barge with one or more relief valves which may be combined with one or more valves provided to relieve gas pressure.

Pressure control of the fluid in the barge or compartments of the barge may be achieved by controlling the admission of water to one or more special compartments of the barge.

Such pressure control may also be obtained by direct water injection into the cargo spaces in the barge. The water compartments may be separated from the remainder of the volume of the barge by fabric diaphragms arranged for instance as flexible cones so that there is little or no stress in the diaphragm.

Alternatively, the water compartment may be in the form of one or more long tubes of fabric loosely connected to the barge at either end. Water may be forced through a hose or hoses connected to the tubes so that they may be filled until the cargo, solid or fluid, is at the desired pressure.

The pressure in the water space or spaces and hence in the cargo-filled compartment or compartments of the bargo is controlled by altering the volume of water in the water space or spaces. The volume may be fixed at the start of the voyage or may be made adjustable by a variety of means. For instance an electric motor or engine or hydraulic motor-driven pump or pumps may be attached to the barge or to a float trailed by the barge. Such pump or pumps may operate either under automatic or remote control to pump water into the pressurising space until the pressure reaches a desired value. If the pressure exceeds the desired value the water may be released through a relief valve.

The pump motors and valves may be powered and controlled by an electric cable passing along the centre of the tow rope which may be of nylon, terylene, steel, courlene or other materials known to be suitable for ropes. The same cable may be used for transmitting information, such as internal pressure readings, as well as for supplying power for navigation lights, radio beacons, etc. Alternatively, information and control signals may be transmitted by radio.

Alternative methods of pressurising either the cargo directly or the water pressurising compartment may involve the use of pressurising gas from metal or plastic storage containers attached to a barge or to a float. The gas may be used to pressurise directly or may drive a water pump or be used in a jet entrainment pump to force water or a mixture of gas and water into the pressurising spaces. In some cases water or gas or mixtures of both may be pumped or blown directly into the cargo spaces. Gas valves responsive to pressure in the barge may operate automatically or may be controlled from the towing vessel by cable or radio.

Other arrangements for tensioning the skin of the barge by longitudinal compartments are ducts of small diameter arranged longitudinally in the centre of or along the walls of the outer skin of the barge. These ducts are pressurised by means similar to those described above so that a longitudinal tension is established in the outer skin. Alternatively, the ducts themselves may become rigid longitudinally and support the remainder of the fabric against the bending stresses which would otherwise cause the barge to buckle and flutter.

High pressure ducts may be pressurised with oil or other fluid cargo or with sea water by pumping such fluid or sea water from the lower pressure compartments or from outside, into them. The pumps may be controlled and powered by means similar to those hereinbefore described. The ducts may be made of fabric which for cheapness may not necessarily be impervious on the internal side when the ducts are filled with fluid cargo

or on the external side when the ducts are filled with sea water. The loss of liquid due to seepage may be made up by the action of the pumps. Seepage also prevents overstressing of the fabric when large forces are suddenly applied to the barge by wave or other action.

Another means of applying pressure to the barge is to pass a hose or flexible pipe from the towing vessel and to pump water, oil or other liquid or gas from the towing vessel when the pressure is low or return it by suction to the towing vessel when the pressure is too high.

The pipe line may be incorporated in the towing rope or cable or may be separate therefrom. In the latter case it may be shortened or lengthened as required by being passed over one or more drums. At each end of the pipe line valves may be installed which may close to seal off the pipe in the event of the occurrence of a fracture or leak. The winches or drums over which the pipe line passes may be arranged to rotate and to alter their distance apart. Several turns about two or more drums may be made so that the length of pipe paid overboard can be materially altered. The rotation of the drums and their distance apart may be controlled to keep in step with the rate of paying out and length of the towing cable.

Preferably the internal pressure inside the barge is at least two or three times the dynamic head of the water flowing parts.

Floating storage vessels may be emptied by displacing the stored material with water pumped into a compartment separated from the storage material by a sealing diaphragm of rubberised fabric which is of sufficient area to avoid stretching under all conditions of filling.

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Agents for the Applicants.

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Published by The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

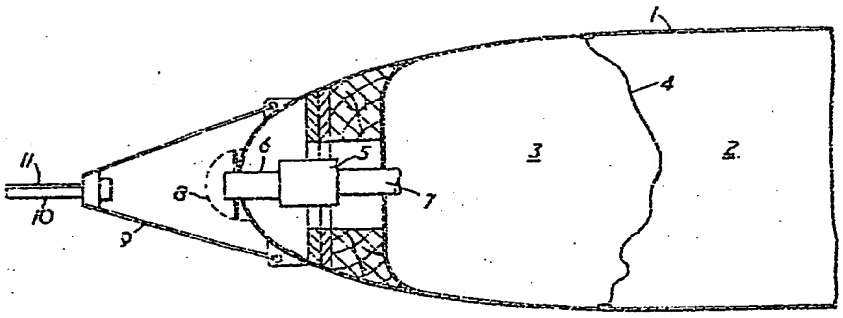

FIG. 1.

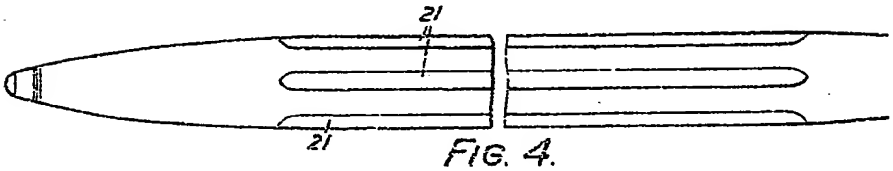

FIG. 4.

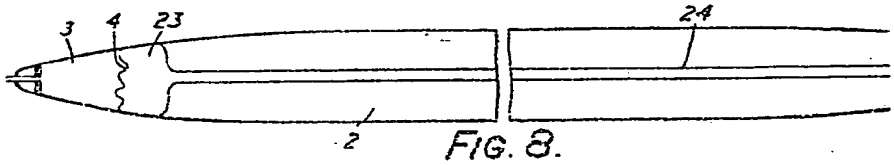

FIG. 8.

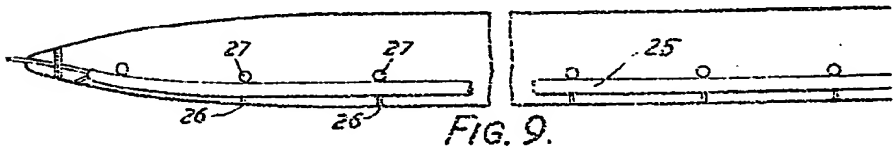

FIG. 9.

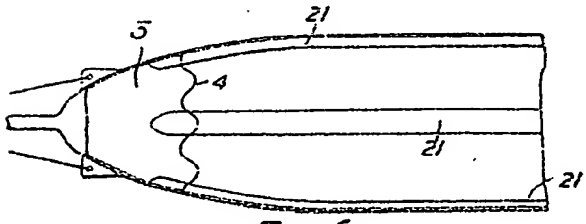

FIG. 6.

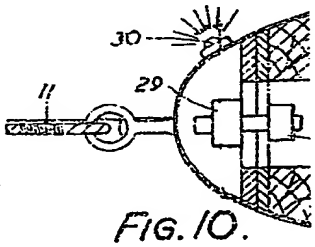

FIG. 10.

824,984 AMENDED SPECIFICATION
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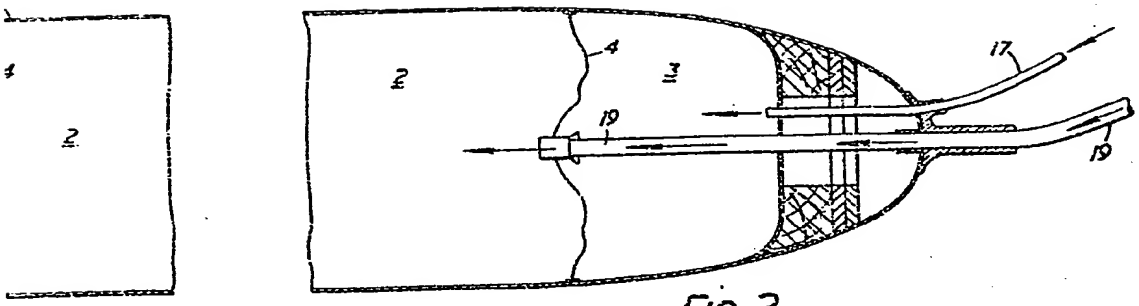


FIG. 2.

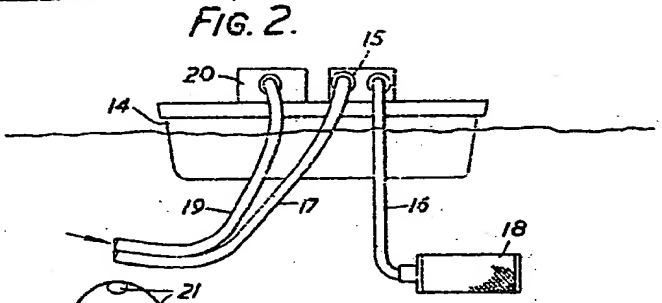


FIG. 3.

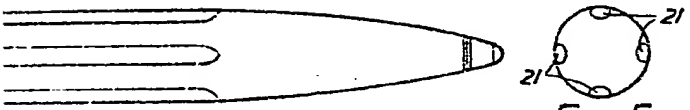


FIG. 5.

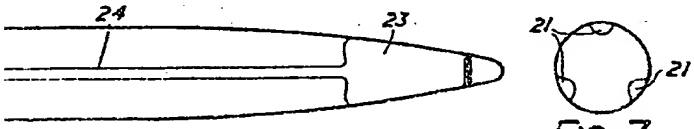
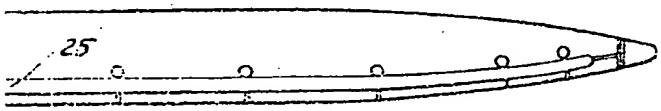


FIG. 7.



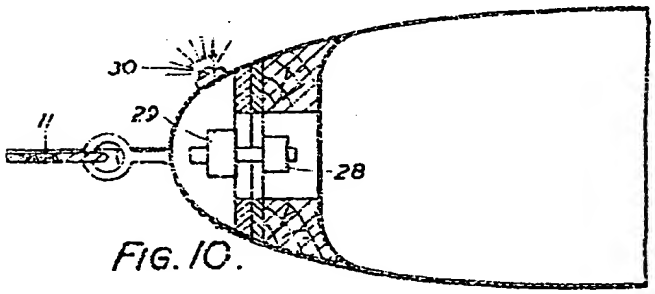


FIG. 10.

824,984 AMENDED SPECIFICATION

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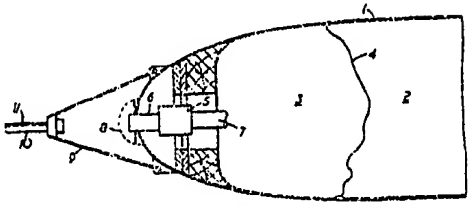


FIG. 1.

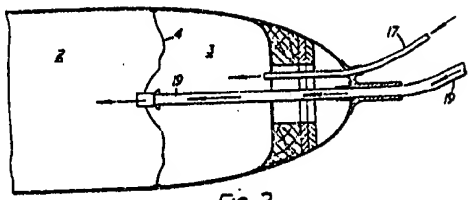


FIG. 2.

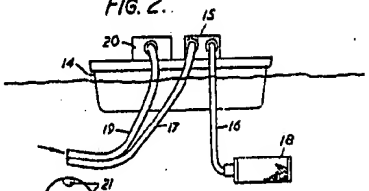


FIG. 3.

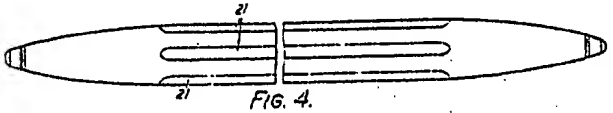


FIG. 4.

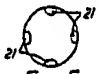


FIG. 5.

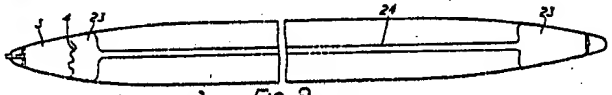
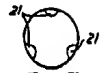


FIG. 8.



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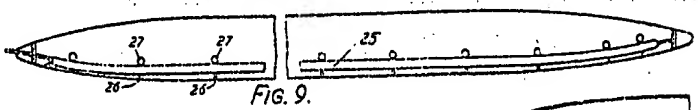

FIG. 9.

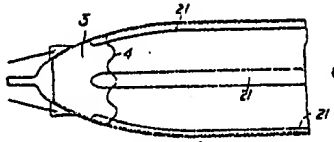

FIG. 6.

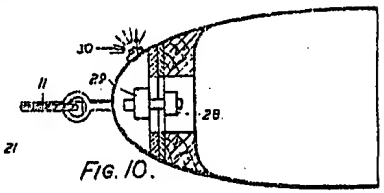

FIG. 10.